Incorporating Industrial Productivity Benefits into the Assessment of Energy Efficiency Investments

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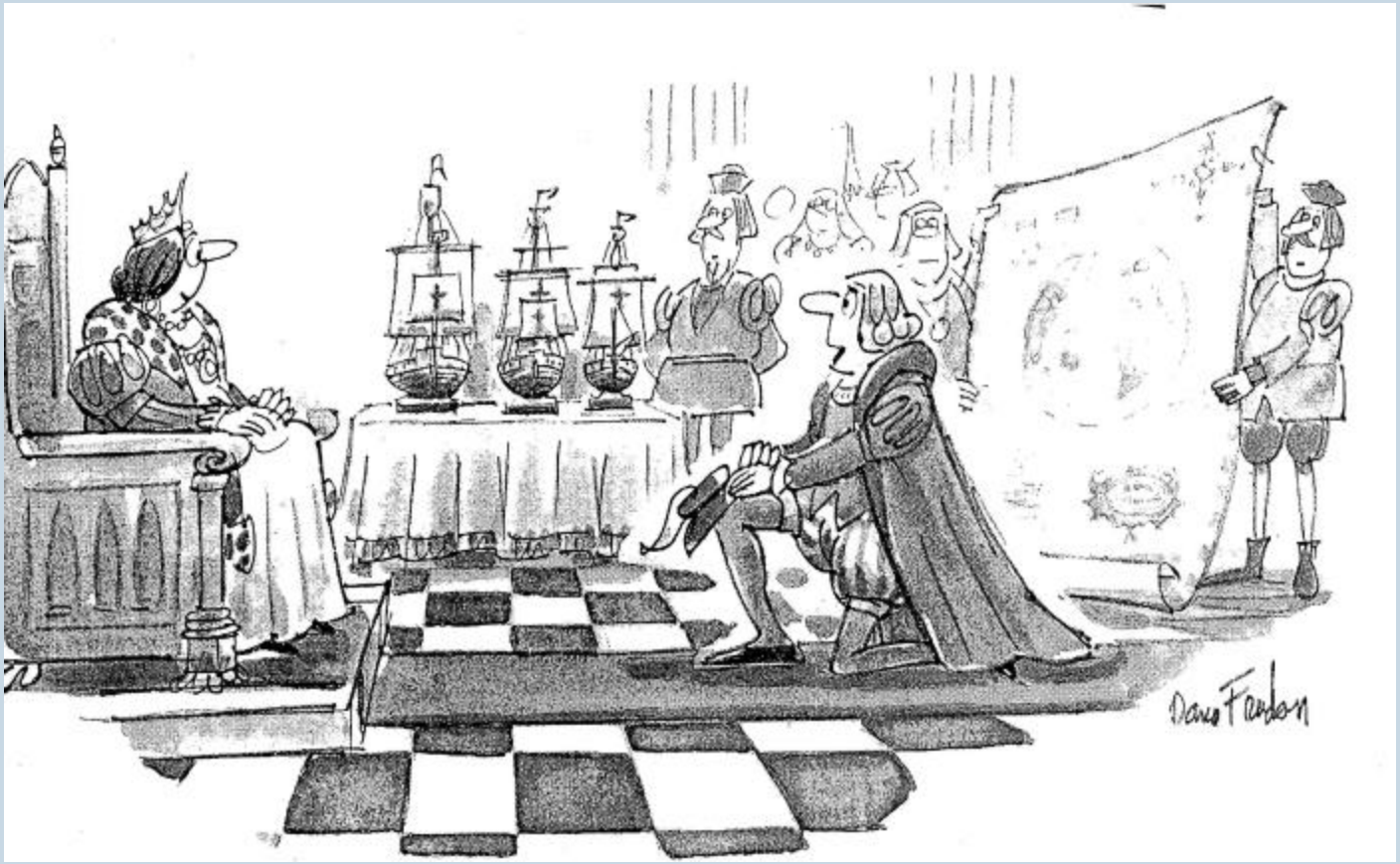


"Your Majesty, my voyage will not only forge a new route to the spices of the East, but it will also increase the productivity of your fleet by 3.2 percent."

Background

- This presentation is based on a recent journal article, "Productivity benefits of industrial energy efficiency measures," by E. Worrell, J. , M. Ruth, and H. , *Energy* 28 (2003), pages 1081-1098.
- Although the preliminary data and anecdotal evidence seemed to imply strong non-energy productivity benefits from industrial energy efficiency investments, there have been few systematic reviews of these impacts until this specific analytical effort was undertaken. At the same time, there is considerably more work that needs to be done to confirm such benefits with any meaningful degree of confidence.

Accounting Framework of Benefits and Costs

	Costs	Benefits
Market	***Accounted***: Investments and O&M expenditures ***Unaccounted***: transaction and search costs	***Accounted***: Energy savings, lower compliance costs ***Unaccounted***: Non-Energy Benefits
Non-Market (Externalities)	Program and R&D expenditures, environmental impacts	Spillover, learning, economies of scale and scope

Note: the term "***Accounted***" refers to those costs or benefits that are typically included in net present
Unaccounted" refers to costs that may be known within the existing regime of prices, but may not necessarily be included in a full cost-benefit analysis.

Categories of Non-Energy Benefits

Waste	Emissions	Maintenance and Operating
Use of waste fuels, heat, gas	Reduced dust emissions	Reduced need for engineering controls
Reduced product waste	Reduced CO, CO2, NOx, SOx	Lowered cooling requirements
Reduced waste water	Lower compliance costs	Increased facility reliability
Reduced hazardous waste		Reduced wear and tear on equipment/machinery
Materials reduction*		Reductions in labor requirements
Production	**Working Environment**	**Other**
Increased product output/yields	Reduced need for personal protective	Decreased liability
Improved equipment	Improved lighting	Improved public image
Shorter process cycle times	Reduced noise levels	Delaying or Reducing capital expenditures
Improved product quality/purity	Improved temperature control	Additional space
Increased Reliability in production	Improved air quality	Improved worker morale

Source: Hodayah Finman, and John A. "Skip" Laitner. "Industry, Energy Efficiency and Productivity Improvements," *Proceedings of the ACEEE Industrial Summer Study*, American Council for an Energy-Efficient Economy, Washington, DC, August 2001.

The Impact of Productivity Gains in 52 Manufacturing Case Studies

	Energy Savings	All Benefits
Savings ($)	$12,933,255	$28,628,837
Payback (Years)	4.2	1.9

The savings from the set of ~$54 million of efficiency investments appears to more than double and the payback more than halves when we include non-energy benefits as well as energy bill savings.

Specific Technology Improvements within the Iron and Steel Industry

- A total of 47 commercially available energy efficiency technologies were reviewed
  - 26 measures specific to integrated steelmaking
  - 11 options specific to electric steelmaking
  - 10 measures that apply to both
- Of the 47 total measures, 14 show strong productivity benefits beyond energy savings

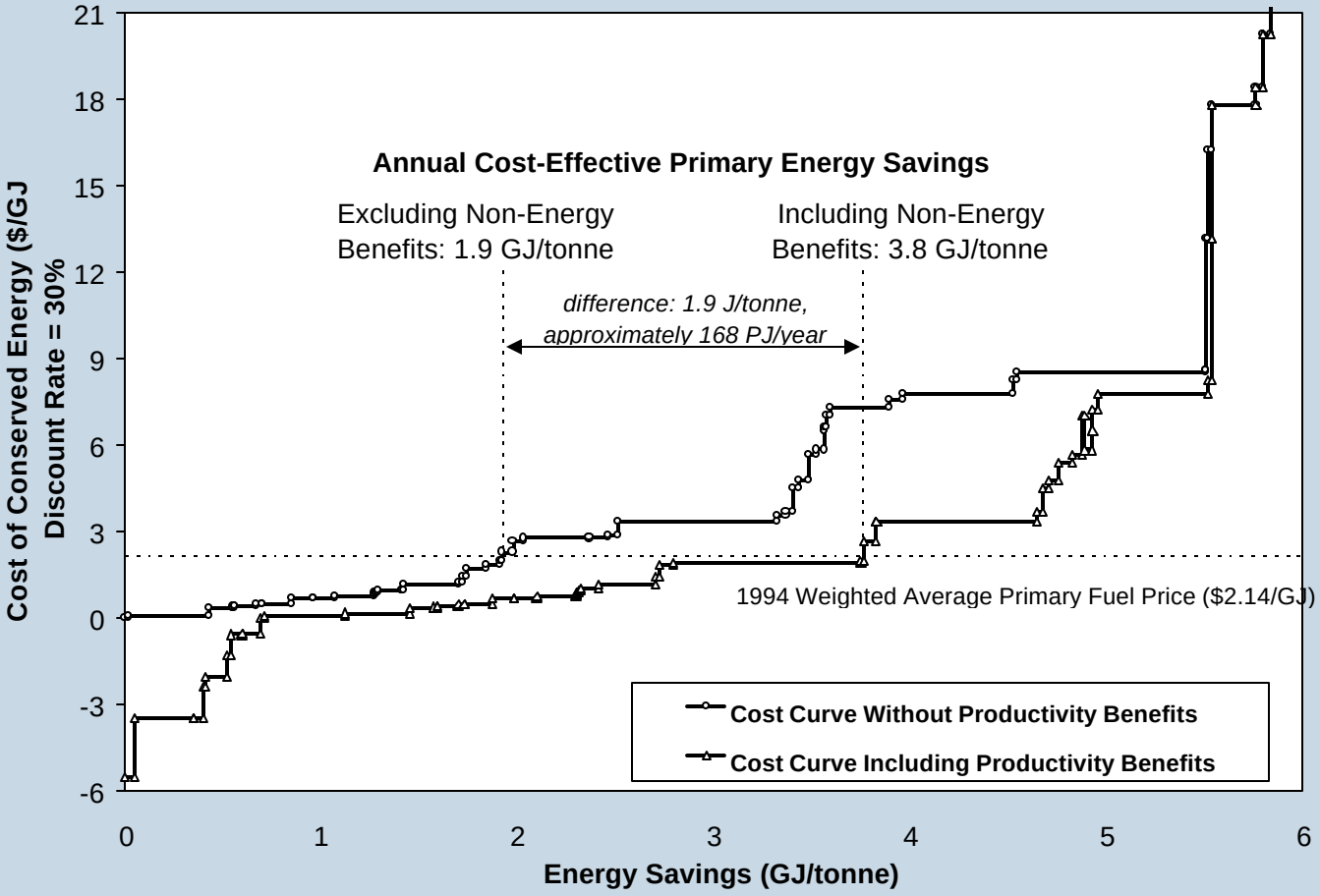
The Accounting Framework

$$CCE = \frac{I \cdot q + M - B}{S}$$

Where

CCE = Cost of Conserved Energy in $/GJ
I = Capital cost ($)
q = Capital recovery factor
M = Annual change in O&M costs ($)
S = Annual energy savings (GJ)
B = annual total of productivity benefits ($)

Conservation Supply Curves for the Iron and Steel Industry With and Without Productivity Benefits



Conclusions

- When we include non-energy productivity benefits together with energy bill savings, the efficiency cost-effectiveness seems to double.
- There are still a number of benefits that are not adequately quantified, but which require new methods to properly account for their impacts.
- Economic models that fail to capture the full set of economic benefits will underestimate market penetration of new technologies as well as underestimate the macroeconomic impacts of the resulting investments.

The difficulty lies not with the new ideas, but in escaping the

John Maynard Keynes

For more information on the material referenced in this presentation, contact:

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